BAT INVENTORY
OF RIPARIAN AREAS
OF THE FORT HUACHUCA MILITARY RESERVATION

1993 - 1994

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TECHNICALITIES

R. Sidner obtained the following permits issued to her to conduct field work for this project: USFWS Endangered Species Subpermit #PRT-676811, Arizona Game and Fish Department license #SDNR0000045, and Ft. Huachuca scientific access permit #94-01.

Administrative coordination was completed with Richard L. Glinski (Nongame Section Supervisor, Arizona Game & Fish Department) and acknowledged by letter (9 June 1993).

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INTRODUCTION

Our primary goal was to initiate a baseline inventory of riparian habitat on Fort Huachuca for the presence of species of bats, and especially for those categorized as sensitive species (as defined by a list from the Arizona Game and Fish Department). The purpose of such an inventory is to identify the species that are present so that management decisions may include actions to protect them and their habitat.

A list of the species of bats that were previously reported from the area is given in Table 1. In 1954, Hoffmeister reported 15 species from the Huachuca Mountains (Hoffmeister and Goodpaster), and 32 years later he reported only one additional species from there (Hoffmeister 1986). From Fort Huachuca, only 9 species were known by 1954, with one more species added to the 1986 account (Hoffmeister 1986). The list of Fort Huachuca bats then climbed quickly to 15 species before we began this Heritage project with the addition of red bats from an Arizona Game & Fish Department Heritage database, pallid bats by Sidner (1990) who was monitoring bat caves on the Fort, and three species (California Myotis, hoary bats, and Brazilian free-tailed bats) that were found in the pellets of spotted owls that nested on the Fort (Duncan and Sidner 1990).

Of the 15 species of bats recorded from Fort Huachuca, four were on sensitive species lists (Arizona Game & Fish Department 1992-1994, USFWS candidate species list, and Fort Huachuca's species of concern list). Six other species from the AZGF Sensitive Species List had the potential to occur on the Fort (*Macrotus californicus*, *Myotis auriculus*, *Lasiurus xanthinus*, *Idionycteris phyllotis*, *Eumops perotis*, and *Euderma maculatum*).

A secondary goal of this project was to provide an initial evaluation of the potential to identify species of bats from recordings of their sonar on equipment that is reasonably priced, convenient to carry in the field, and for which recent literature has suggested such a possibility (Fenton and Bell 1981).

PROCEDURES

We set mistnets over streams, pools in streambeds, or waterholes in five canyons on Fort Huachuca (see Appendix 1 for details of the localities). Twelve nights of netting were attempted, but adverse weather prevented work on two evenings.

Different numbers and sizes of nets were set according to conditions at each site (See Appendix 1). Over narrow stream channels, 5 and 9 meter length nets were set, and these were set as stacked nets when height of the corridor permitted it. Over larger bodies of water, 12 and 18 meter length nets were set, and over the largest bodies of water, Garden Canyon Lower Pond and Woodcutter Canyon Pond, two 18 meter nets were tied end to end to cover the width (120 feet) of the ponds at a narrow end. A boat was necessary for setting such nets and retrieving the bats.

All bats that were netted (that did not escape) were identified to species, and noted for sex, age, and reproductive stage. Forearm measurements and body mass were recorded for representative numbers along with other assorted notes regarding health or anomalies. These observations recorded from individuals are listed in Appendix 2.

One bat from Garden Canyon Pond, netted on 3 Sept 1993, was retained for preparation as a museum specimen (Appendix 3). The specimen was prepared by Sidner and the skull and skin have been deposited at the University of Arizona Mammal Collection. Sidner has examined the skin and measured the cleaned skull for species identification.

All other bats were released alive in the Canyon where they were netted. Those that were released before netting was finished for a night were marked with a temporary marker (non-toxic paint placed between scapulae).

Some of the netted bats were subjected to light tagging, so that when they were released during the night, we could keep them in sight in order to be certain from which bat in flight we were recording a sample of sonar. For this process, a toothpick was used to apply a small amount of colostomy adhesive (medically-approved) to fur on the mid-dorsum, and a small cyalume stick was adhered to the adhesive. Two sizes of cyalume tags were used: a 39 mm/0.6 g tag for large bats and a 23 mm/0.2 g tag for small bats. We found that light tags, while entertaining to watch, caused obvious stress to the bats. Some bats immediately landed and remained hungup in a tree for up to 45 minutes. Others flew immediately out of sight. With only one recording setup

(microphone and detector attached to tape recorder) available, and because the bats tended to abandon the area immediately, we usually were not able to record a bat for more than a few moments upon release. For this reason, we felt the light-tag yielded too little data for the stress it must cause the bats, and we stopped using light tags on many bats. We found that we got better recordings and could follow the animal better by releasing them in early daylight. However, while the dawn release worked best for our purposes (although bats may use sonar differently in daylight), it is difficult to know which method is more harmful to these animals (see Extras, Photographs section for description of problems of daylight release).

Photographs were taken of each species for documentation purposes (see Appendix 4). See the section on Extras, Photographs to document species.

Recordings of sonar were made from most species of bats (see Appendix 5). See the sections on Extras, Recordings of bat sonar, and Analysis of feasibility of using simple sonar detectors for identification of species.

RESULTS AND DISCUSSION

Nets set on ten nights yielded bats (see Appendix 1 for details regarding environmental conditions, and netting efforts at each locality).

We netted 13 species of bats in riparian areas of Fort Huachuca during this project (Table 2), and one *Plecotus townsendii* was netted in Slaughterhouse Wash while fieldwork was underway on a different project on 6 Aug 1994. Although no additional *Plecotus* were caught during fieldwork for this project, we have included that one in our species list here because that riparian drainage was later netted as part of this project.

One species that was netted during this project, *Myotis auriculus*, had been recorded previously from the Huachuca Mountains but not from the Fort; and two other species, *Lasionycteris noctivagans* and *Myotis occultus* (Table 2), are new records for both the Fort and the Huachuca Mountains (Table 1).

A list of the potential species of bats that could occur on Fort Huachuca is provided in Table 3 along with a numerical summary of each species that was netted at each locality and date. The tally of individuals of each species that were netted on any night does not include any repeat captures; no marked bats were ever caught a second time. The most abundant species in our samples, and the one found at the most sites (6 of 8) and dates (7 of 10) was *Eptesicus fuscus*. The second most abundant species in our total was *Tadarida brasiliensis*, but they occurred on only 4 dates at only 3 localities; these were the areas with large bodies of water or otherwise broadly-open access to them.

Analyses of the netting success and amount of netting effort at each locality on different dates are compared in Table 4. Netting success is measured by species diversity and abundance. Netting effort is defined here as the number of nets, times their length, times the number of hours that those nets are set open; the resulting net-meter hours make comparison easier between sites and even between projects. Two measures of the success and effort combined are the capture rate, the number of bats per net-meter hour, and the effort rate, the number of net-meter hours invested per bat.

Species diversity was highest (8 species) at Tinker Canyon Pond, where only one night of netting was performed in June 1994. Whether it was the site or the June date or the netting effort, that permitted such high diversity is not possible to tell. The second highest species diversity, 6 species, were recorded at four localities in May, June, and August. The lowest diversity (and abundance) that we experienced, 2 species, occurred at Woodcutter Pond in

June 1994 during a night of the second highest netting effort, but during which wind blew continuously, billowing the nets. Because of this apparent effect of weather, we have not included netting effort or success data from that date in the final totals (Table 4).

Abundance of bats also varied by locality and date, with the highest abundance, 27 bats, occurring at 3 sites in May and June of 1994 (Table 4). A comparable date in 1993 yielded comparable species diversity but less than half the abundance; the netting effort was slightly lower, the site was at higher elevation and experienced temperatures at least 10°C lower.

An obvious presumption is that netting success increases with netting effort. This was not the case on Fort Huachuca. There is no correlation between species diversity and netting effort (r=0.07, P=0.83) or between bat abundance and netting effort (r= -0.15, P=0.67). For example, at Huachuca Canyon, where species diversity (although not the same species) and abundance remained the same on two comparable dates but in different years, the increase in netting effort there in 1994 (the highest netting effort at any locality) did not change the netting success. The effort rate (Table 4) removes the bias of the amount of netting effort on netting success. Comparison can then be made in terms of the number of net-meter hours that are necessary to capture one bat at each locality. This number varies from about 4 to 67 n-m hr/bat. The three localities where the least effort was necessary to capture one bat do not share a common variable to explain the low effort/high success rate.

The total species diversity by month in riparian areas of Fort Huachuca varied from 6 to 9 species throughout May to September (Table 5) and additional sampling might show total diversity to be the same each month. But the species composition varies to some extent from spring to fall. For instance, *Eptesicus* were netted during every month, but *Leptonycteris* were only taken in August and September (although they have also been taken in October; Sidner 1992) in riparian areas. The other sensitive species were taken in such low numbers that their monthly patterns can only be suggested here. *Myotis auriculus* was only taken in May through July, *Choeronycteris* were only taken from July through September (although they have been taken in October; Sidner 1992), and *Lasiurus blossevillii* have been taken in scattered months so perhaps they are present all year. *Lasionycteris* were only taken in May and June; perhaps this is why they have not been recorded before in the Huachucas.

The sex and age of netted bats are listed in Table 6. Some species are so few in captures that generalities about them cannot be supported. For example, not much can be said about the only captured *Myotis occultus*, an adult male,

but 87% of the 49 netted *Eptesicus* were adult males, suggesting that at the elevations we netted in the Huachucas in the summer, this is where adult males go rather than adult females. On the other hand, all 25 *Tadarida brasiliensis* that were netted were adults, but they occurred in equal representation of the sexes. All 10 of the *Lasiurus cinereus* and *Lasionycteris noctivagans* netted were adult males. *Myotis velifer*, on the other hand, was equally represented between males and females and adults and juveniles. Six of the 13 species netted were represented by at least one juvenile animal.

A record was kept of the time of night of all captures. In Table 7, captures are given by time of night when the night is divided arbitrarily into 3 times: from sunset until 2200 h, 2201 to 0100 h, and 0101 to before sunup. These times are not equal but were chosen to make a point about relative activity patterns of species of bats. Nets were not open equally during all three periods for all sessions, because of weather, or because we closed nets during busy times in order to record body measurements or to record sonar from captives. However, for a few species, there are enough captures over the entire 3 periods to make some generalizations. Some species appear to be caught almost exclusively at one time period. *Pipistrellus* tend to be caught in the first period, although if nets were open just before dawn frequently enough, they might be captured more then. *Leptonycteris* (from this project and others we have conducted at Fort Huachuca in riparian areas) tended to be netted in the first 2 periods. *Myotis velifer* is netted at all times nearly equally. *Eptesicus* may be captured prominently in all time periods with decreasing frequency as the evening wears on. *Tadarida brasiliensis* was most frequently captured during the midnight period. At least 16% of our total captures were netted during the last period, however, no species was exclusively caught during that time. Thus, sampling abundance may be increased by late night (morning) netting, but not necessarily species diversity.

An updated species list of the bats recorded from Fort Huachuca is given in Table 8. A total of 18 species of bats are now known to occur on Fort Huachuca.

THE EXTRAS

Photographs to document species.

Each species that was netted was photographed for the purpose of documentation. However, not all photographic attempts were successful. The best photographs resulted when a bat was retained overnight and photographed in daylight. This is potentially damaging to bats, however, because they are exposed to the danger of daytime predators and altered environmental temperature and humidity, and because they may not be able to feed or drink. For this reason, nectarbats were not held overnight, nor were pregnant or lactating females of any species (except a *Tadarida* that was netted within an hour of dawn). A few species were netted on only one or two occasions and this did not permit opportunity to correct for unsuccessful photographic attempts. For these reasons, there are no photographs of *Choeronycteris*, *Myotis occultus* (but there is a specimen of this species), and *Myotis volans*.

One documentary photograph of each of the other 10 species of bats that were netted during the project are included within this report (see Appendix 4 and Photographs 1 - 10). All other photographs and negatives are included in a separate packet.

Recordings of bat sonar.

Attempts were made to obtain recordings from nearly all species of bats emitting ultrasonic calls. Many of these attempts were unsuccessful for a variety of reasons. The microphone of the bat detector is very sensitive to humidity; therefore, recording was not successful on rainy or otherwise very humid nights. Wind caused unwanted noise in the microphone. Insects caused unwanted noise as well.

Despite these problems, recordings were made. In addition to recordings of bats from Fort Huachuca, we have compiled and included recordings of bats from the Buenos Aires National Wildlife Refuge, the Rincon Mountains, and the Catalina Mountains in order to increase the sample size, species diversity, and potential success for identification purposes. Recordings are included from 14 species of bats. See Appendix 5 for a list of these recordings. Four original cassette tapes of these compiled recordings are included in a separate packet.

Among the problems with these recordings is that very few of them are normal echolocation or "search" cries. We attempted to get such calls by tagging the bats with visible and identifiable light tags (or by releasing them in early morning light so that we could actually keep them in sight), releasing them, and recording their sounds. To do so, one of us held the bat and released it "warmed up", wings outstretched, toward the other observer who held the microphone, detector, and recorder. Almost all bats departed the area immediately so that recordings of normal "search" cries were not possible, unless the bat circled back. This happened on a rare occasion, and generally only with molossids which have a habit of circling while gaining altitude.

The effectiveness of these recordings for the purpose of species identification is discussed below.

These tapes could certainly be used for educational and conservation purposes. When I play such tapes to an audience during an educational "bat conservation" lecture, audience members always respond enthusiastically and are delighted by their new appreciation of bats' abilities (especially when a good-quality audio system is used to project the sounds).

Analysis of the Feasibility of Using Sonar Detectors to Identify Bats.

We used two kinds of sonar detectors for this project. For the purpose of recordings, we used an "S-25 bat detector" from Ultra Sound Advice. This compact and lightweight detector is the same size as the simpler "Mini bat detector" (QMC brand) and its clones that are commonly in use. The "mini" has the advantage of costing less (about $200-275), being durable and dependable in a variety of environmental conditions (not affected much by humidity), but it has the distinct disadvantage of hearing a vary narrow band of frequency at one time. Tuned to one frequency at a time, this detector does not hear a bat calling at a different frequency. For this reason, we used "mini" detectors only for getting an impression of bat activity at a site, or when environmental humidity prevented use of the other detector.

The "S-25" costs more (about $1000), has sensitivity problems with humidity, is purchased from overseas (so that exchange rates and customs charges occur, and repair becomes a problem), and it may tend to have electronic problems (mine lost its ability to "hear" and transmit the human voice for recording voice messages for reference commentary during the process of recording bat sonar). But the "S-25" has two important advantages. It hears a

very wide band of frequency so that it hears bats calling at any frequency (provided the bat is loud enough), and it has switches to "slow-down" the sonar calls so that they are more easily interpreted by the listener.

The "S-25" was attached to a small, portable Sony WM-D6C professional tape recorder with Dolby capabilities (about $500; but cheaper recorders are probably nearly as effective). We used Type-II metal recording tapes to reduce noise and increase performance.

With this equipment, we were able to make relatively good recordings of some species of bats. HOWEVER, THE EFFECTIVENESS OF THESE RECORDINGS FOR PURPOSES OF SPECIES IDENTIFICATION IS QUESTIONABLE.

Use of sonar calls of bats for identification purposes is possible under certain conditions. In a friend's laboratory, we used a specialized laboratory microphone and variable speed reel-to-reel tape recorder to record sonar from hand-held bats in a sound chamber. We played these tape recordings of bats into my MacIntosh computer with the simple sound-editing programs, MacRecorder and SoundEdit. We were able to get good sonagraphs of bat calls.

But what we wanted to do was to get some kind of sonagraph using the relatively cheap and very portable equipment outlined above so that repeated samples could be compared in order to measure statistical confidence when making claims of species identification (Fenton and Bell 1981, Brigham et al. 1989).

We tried to use the bat sonar recordings from the "S-25". These recordings would not be of the same type as those we made in the laboratory, but we hoped to get simple graphs of the temporal patterns (just repetition rates) of calls of bats. (For example, the staccato clicking of a bat that is heard on a "mini" detector should show up in the MacRecorder program. However, when we played our recordings from either the "mini" or the "S-25" into the computer, we found that there is too much microphone and detector noise so that the computer can't pick up the recorded calls.

Our preliminary work with simple sonar detectors has suggested thus far, that in order to use detectors for species identification of bats, future work will necessitate one of the following.

1) Expensive detectors, microphones, recording devices, and output monitors (already accomplished under laboratory conditions; there is abundant literature on such). This was not the purpose of our proposed initial evaluation.

2) "Mini" or "S-25" type detectors, microphones, and recorders. It is unlikely that these will provide reliable species identification, but with much practice, observers could become relatively familiar with a limited number of species under certain conditions and might be able to say with some confidence that a particular call is possibly species "X." For management purposes, when dealing with "listed" species and the necessity of identification, this method would not be reliable. At best, it would be necessary for someone to painstakingly make repeated recordings for **each** species under a variety of conditions, for which multiple samples were available for each condition at many different frequency settings and division ratios. Even then, it would be necessary to calibrate both the detector and the observer's ear to a particular machine and give a subjective analysis of what they think the species is.

3) New detectors with compatible computer programs are becoming available. For example, the "Anabat" detector (with wide band frequency detection and "slow-down" switches, at a reasonable price of about $500) may be useful. Near the end of this project, I purchased an "Anabat" and it is possible to record from it and then feed the information into another machine (for another $500) that can be hooked up to a computer with the Anabat program and get a sonagraph. However, even if this does work, this setup still has the statistical problems outlined in 2) above.

RECOMMENDATIONS FOR MANAGEMENT

Because of the military mission of the Fort Huachuca Army Garrison, there is a high potential for damage to the environment there. The Fort has a diverse biota, in part because of its proximity to the southern tropical species that occur in Mexico. Thus, there is a special need to know what sensitive species are present on the Army installation. Through their game management branch, the Army has been working to sustain Fort Huachuca's natural environments for the future.

To continue and further the Army's efforts to protect bats and their habitat on Fort Huachuca, we recommend the following:

1) Protect riparian areas from non-natural changes in such things as water flow, water quality, vegetation type and structure, etc.

2) Continue sampling over a few more years to "complete" the list of the species of bats that occur on Fort Huachuca. Ten nights of sampling over two years is insufficient effort to determine all the species that may occur.

However, our state of knowledge is such that in the future a tremendous increase in surveying effort will likely yield very little new species information (Sidner and Davis 1994). This sampling would probably be most effective by sampling different areas or by using different techniques, such as setting higher nets to capture bats that fly or feed at greater heights off the ground.

Another way to effectively continue sampling would be to establish a monitoring program of some representative riparian areas. These would be netted each time under comparable environmental conditions, e.g., summer months, moon phase, non-stormy weather conditions, same number and placement of nets, same hours of the night, etc. Relative bat activity, if not species identification, could be determined with a sonar detector attached to a data logger. Observations from such monitoring activities could be compared over time to determine whether changes occur in bat activity or in species composition.

3) Identify the skeletal remains (to bat level) in owl pellets and have them identified by qualified biologists to look for additional species of bats or change in species composition in the pellets over time.

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TABLES

Table 1. List of the species of bats previously recorded from the Huachuca Mountains and specifically from Fort Huachuca prior to this study. Source of the first record of each species is given. Species of bats that are on the Arizona Game & Fish Department - Sensitive Species List (1992-1994) are printed in boldface. Totals given at the bottom are total species recorded from the Huachuca Mountains and from Fort Huachuca before this study.

Huachuca Mountains (Hoffmeister 1954) (Hoffmeister 1986)	Fort Huachuca	
	(Hoffmeister 1954) (Hoffmeister 1986)	(AZGF Heritage database) (Duncan&Sidner 1990) (Sidner 1990)
L. curasoae	***L. curasoae***	
C. mexicana	***C. mexicana***	
M. auriculus		
M. californicus		*M. californicus* D&S 1990
M. ciliolabrum	*M. ciliolabrum*	
M. thysanodes	*M. thysanodes*	
M. velifer	***M. velifer***	
M. volans	*M. volans*	
M. yumanensis		
L. blossevillii		***L.blossevillii*** AZGF
L. cinereus		*L. cinereus* D&S 1990
P. hesperus	*P. hesperus*	
E. fuscus	*E. fuscus*	
P. townsendii	*P. townsendii*	
A. pallidus		*A. pallidus* Sidner 1990
--		*T. brasiliensis* D&S 1990
N. femorosaccus	*N. femorosaccus*	
16 species	10 species	5 species
	15 species recorded from Fort Huachuca	

Table 2. List of the bat species netted in riparian areas of Fort Huachuca during this project.

Leptonycteris curasoae	Lesser Long-nosed Bat
Choeronycteris mexicana	Mexican Long-tongued Bat
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Myotis auriculus	Southwestern Myotis
Myotis occultus	Arizona Myotis
Myotis thysanodes	Fringed Myotis
Myotis velifer	Cave Myotis
Myotis volans	Long-legged Myotis
Lasiurus blossevillii	Western Red Bat
Lasiurus cinereus	Hoary Bat
Lasionycteris noctivagans	Silver-haired Bat
Pipistrellus hesperus	Western Pipistrelle
Eptesicus fuscus	Big Brown Bat
* *Plecotus townsendii*	Townsend's Big-eared Bat
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Tadarida brasiliensis	Brazilian Free-tailed Bat

* Townsend's Big-eared Bat was netted at this site on 6 August 1994 during a different project.

Table 3. Species and numbers of bats netted, by locality and date of capture. The list is extended to include all the species that may yet be possible from the area.

Species	Locality and Date, 1993			
	Upper Garden Canyon 6200' 7-8 Jun	Huachuca Canyon 5650' 3-4 Aug	Woodcutt. Pond 5150' 11-12 Aug	Garden Canyon Lower Pond 4925' 3 Sep
Macrotus californicus				
Choeronycteris mexicana				
Leptonycteris curasoae			3	
Myotis auriculus	1			
Myotis californicus				
Myotis ciliolabrum				
Myotis occultus				1
Myotis thysanodes			2	
Myotis velifer		1	3	7
Myotis volans	1			
Myotis yumanensis				
Lasiurus blossevillii				1
Lasiurus cinereus	2	1		

Lasiurus xanthinus				
Lasionycteris noctivagans	1			
Pipistrellus hesperus	2		3	
Eptesicus fuscus	4	3	5	
Euderma maculatum				
Plecotus townsendii				
Idionycteris phyllotis				
Antrozous pallidus				
Tadarida brasiliensis			1	
Nyctinomops femorosaccus				
Nyctinomops macrotis				
Eumops perotis				

Table 3 continued...

Species	Locality and Date, 1994			
	Garden Canyon 5350' 22-23 May	Garden Canyon upper Pond 4925' 2-3 June	Tinker Pond 5375' 17-18 June	Woodcutt. Pond 5150' 24-25 June
Macrotus californicus				
Choeronycteris mexicana				
Leptonycteris curasoae				
Myotis auriculus	3		1	
Myotis californicus				
Myotis ciliolabrum				
Myotis occultus				
Myotis thysanodes	4		1	
Myotis velifer				
Myotis volans			1	
Myotis yumanensis				
Lasiurus blossevillii		2	2	
Lasiurus cinereus	1	1	2	
Lasiurus xanthinus				
Lasionycteris noctivagans	1	1		

Pipistrellus hesperus	1	1	2	1
Eptesicus fuscus	17	1	16	
Euderma maculatum				
Plecotus townsendii				
Idionycteris phyllotis				
Antrozous pallidus				
Tadarida brasiliensis		21	2	1
Nyctinomops femorosaccus				
Nyctinomops macrotis				
Eumops perotis				

Table 3 continued...

Species	Locality and Date, 1994	
	Huachuca Canyon 5650' 27-28 July	Slaughterh. Wash 4825' 26-27 Aug
Macrotus californicus		
Choeronycteris mexicana		2
Leptonycteris curasoae		7
Myotis auriculus	1	
Myotis californicus		
Myotis ciliolabrum		
Myotis occultus		
Myotis thysanodes		
Myotis velifer		6
Myotis volans		
Myotis yumanensis		
Lasiurus blossevillii	1	
Lasiurus cinereus		
Lasiurus xanthinus		
Lasionycteris noctivagans		

Pipistrellus hesperus		
Eptesicus fuscus	3	
Euderma maculatum		
Plecotus townsendii		
Idionycteris phyllotis		
Antrozous pallidus		
Tadarida brasiliensis		
Nyctinomops femorosaccus		
Nyctinomops macrotis		
Eumops perotis		

Table 4. Netting success and netting effort as measured by species diversity, bat abundance, netting effort, capture rate, and effort rate by locality and date of capture. Net-meter hours are the number of hours that nets were open multiplied by the length of the nets. Capture rate is the number of bats caught per net-meter hour. Effort rate is the number of net-meter hours necessary to capture one bat. Subtotals include all data. Final totals do not include data from Woodcutter Pond on 24-25 June 1994 during bad weather.

Locality and Date	Species Div.	Bat Abund.	Netting Effort (n-m hrs)	Capture Rate (bat/n-m hr)	Effort Rate (n-m hr/bat)
Upper Garden Canyon 7-8 June 1993	6	11	162	0.068	14.7
Huachuca Canyon 3-4 Aug 1993	3	5	273	0.018	54.6
Woodcutter Canyon 11-12 Aug 1993	6	17	253	0.067	14.9
Gard.Cany.Low.Pond 3 Sept 1993	3	9	144	0.063	16.0
Garden Canyon Picnic 22-23 May 1994	6	27	262	0.103	9.7
Gard.Cany.Upp.Pond 2-3 June 1994	6	27	157	0.172	5.8
Tinker Canyon Pond 17-18 June 1994	8	27	306	0.088	11.3
Woodcutter Pond * 24-25 June 1994 SKIP	2 bad	2 weather	306 bad	0.007 weather	153.0 skip
Huachuca Canyon 27-28 July 1994	3	5	333	0.015	66.6
Slaughterhouse Wash 26-27 Aug 1994	3	15	56	0.268	3.7
Subtotals ($\bar{x}$ values)	2 - 8 (4.6)	145 (14.5)	2152 (225)	0.067	14.8 (35.0)
Final Totals*	3 - 8 $\bar{x}$=4+	143	1846	0.077	12.9

Table 5. Monthly occurrence of species of bats netted in riparian areas of Fort Huachuca during this project. Number of sampling periods for this project during which bats were netted are noted below each month. Some species have been netted in Slaughterhouse Wash during other projects but are included here for comparison and are designated by (*).

Species	Months				
	May 1	Jun 4	Jul 1	Aug 3	Sep 1
Leptonycteris curasoae				*	(*)
Choeronycteris mexicana			(*)	*	(*)
Myotis auriculus	*	*	*		
Myotis occultus					*
Myotis thysanodes	*	*	(*)	*	
Myotis velifer			(*)	*	*
Myotis volans		*			
Lasiurus blossevillii		*	*		*
Lasiurus cinereus	*	*		*	
Lasionycteris noctivagans	*	*			
Pipistrellus hesperus	*	*		*	
Eptesicus fuscus	*	*	*	*	(*)
Plecotus townsendii				(*)	
Tadarida brasiliensis		*		*	
Species Diversity (14)	6	9	6	9	6

Table 6. Sex and age of the netted species of bats. A * indicates that a bat escaped before age or sex could be determined.

Species	Sex		Age		Total Captures
	male	female	adult	juv.	
L. curasoae	3	7	4	6	10
C. mexicana	2	--	1	1	2
M. auriculus	2	4	6	--	6
M. occultus	1	--	1	--	1
M. thysanodes	1	6	5	2	7
M. velifer	9	8	9	8	17
M. volans	--	2	2	--	2
L. blossevillii	2	4	5	1	6
L. cinereus	7	--	7	--	7
L. noctivagans	3	--	3	--	3
P. hesperus	6	3	9	--	10*
E. fuscus	43	5	46	2	49*
T. brasiliensis	13	12	25	--	25

Table 7. Species of bats by time of night that they were netted. Total captures reflect only those bats that were netted during a date when nets were available for all three time periods. An * indicates that a species was caught during that particular period even when a comparison is not warranted because nets were not available during all periods. A -- indicates that nets were not available during this time period during a date when that species was actually caught. Numbers in ( ) next to totals represent the percent of total bats caught that were netted during that time period.

Species	Time of Capture			
	< 1900-2200	2201-0100	0101-0400 >	Total Caught
Leptonycteris curasoae	*	3	0	3
Choeronycteris mexicana	*	--	--	0
Myotis auriculus	5	1	0	6
Myotis occultus	*	--	--	0
Myotis thysanodes	5	2	0	7
Myotis velifer	5	2	3	10
Myotis volans	2	0	0	2
Lasiurus blossevillii	3	0	2	5
Lasiurus cinereus	3	3	1	7
Lasionycteris noctivagans	2	1	0	3
Pipistrellus hesperus	9	0	1	10
Eptesicus fuscus	30	10	9	49
Tadarida brasiliensis	8	13	4	25
Total	72 (57)	35 (28)	20 (16)	127

Table 8. Updated species list of bats from Fort Huachuca. Sensitive species are printed in boldface. Species that were recorded from either the Huachuca Mountains or specifically from Fort Huachuca before this study are given in the first two columns. Species newly recorded on the Fort during this study are listed in the third column. An * indicates that a species was netted in riparian areas of Fort Huachuca during this study. Totals given at the bottom are total species recorded from the Huachuca Mountains and from Fort Huachuca before this study, total species netted in riparian areas during this study, and total species now recorded from Fort Huachuca.

Huachuca Mountains (Prior to this study)	Fort Huachuca	
	Prior to this study	Results of this study
L. curasoae	***L. curasoae***	*
C. mexicana	***C. mexicana***	*
M. auriculus		* ***M. auriculus***
M. californicus	*M. californicus*	
M. ciliolabrum	*M. ciliolabrum*	
		* *M. occultus*
M. thysanodes	*M. thysanodes*	*
M. velifer	***M. velifer***	*
M. volans	*M. volans*	*
M. yumanensis		
L. blossevillii	***L. blossevillii***	*
L. cinereus	*L. cinereus*	*
		* *L. noctivagans*
P. hesperus	*P. hesperus*	*
E. fuscus	*E. fuscus*	*
P. townsendii	*P. townsendii*	*
A. pallidus	*A. pallidus*	
T. brasiliensis	*T. brasiliensis*	*
N. femorosaccus	*N. femorosaccus*	
17 species before	15 species	* 14 species netted
Total species of bats from Fort Huachuca		18 species recorded